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Task Order 0006

**MONITOR WELL LOCATIONS FOR
THE ROCKY MOUNTAIN ARSENAL OFFPOST
GEOTECHNICAL (DRILLING) PROGRAM**

ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.
7332 So. Alton Way, Suite H
Englewood, Colorado 80112

May 16, 1985

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Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, MD 21010*

Prepared for

U. S. ARMY TOXIC AND HAZARDOUS WASTE MATERIALS AGENCY
Assessment Division
Aberdeen Proving Ground, Maryland 21010

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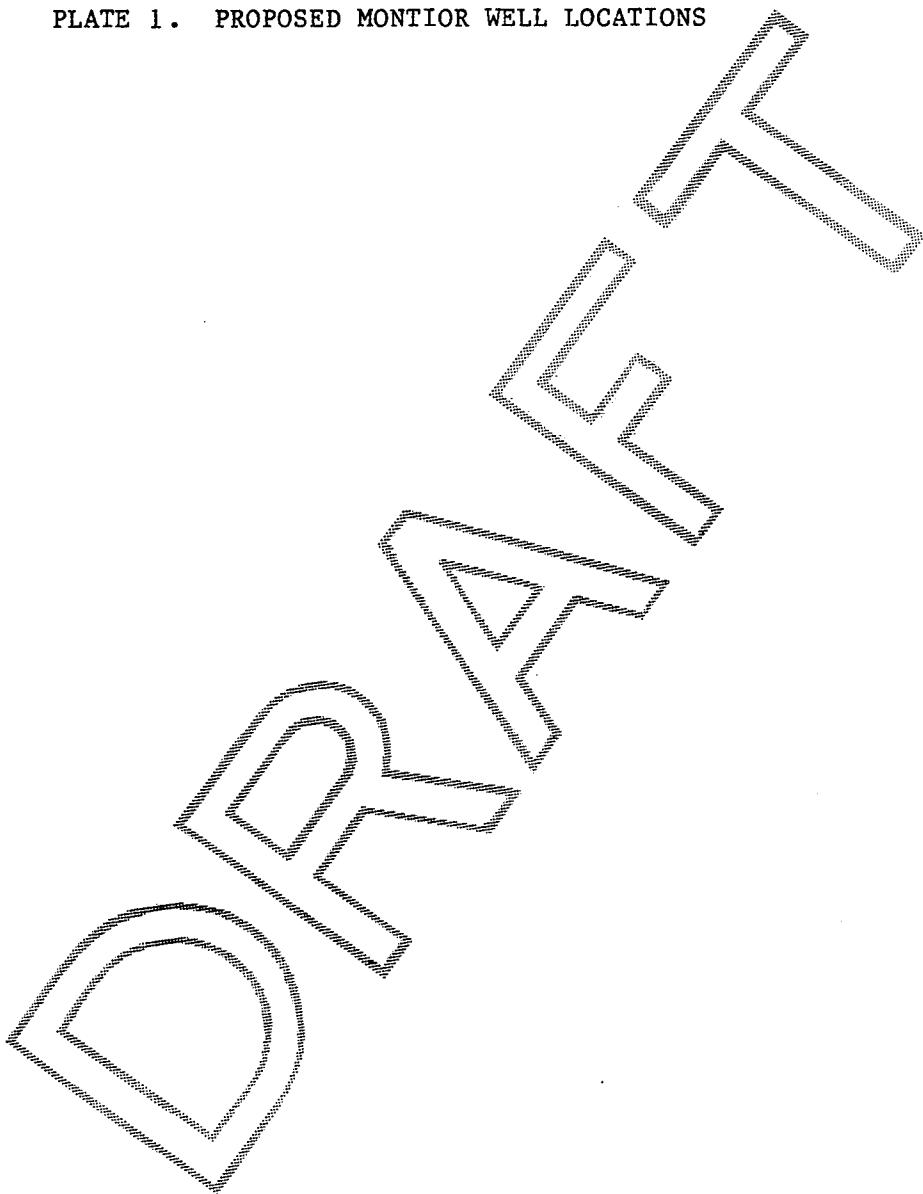
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TABLE OF CONTENTS

| <u>Section</u> | <u>Page</u> |
|------------------------------------|-------------|
| 1.0 INTRODUCTION | 1-1 |
| 2.0 MONITOR WELL NETWORK RATIONALE | 2-1 |
| 3.0 WELL SITE DESCRIPTION | 3-1 |

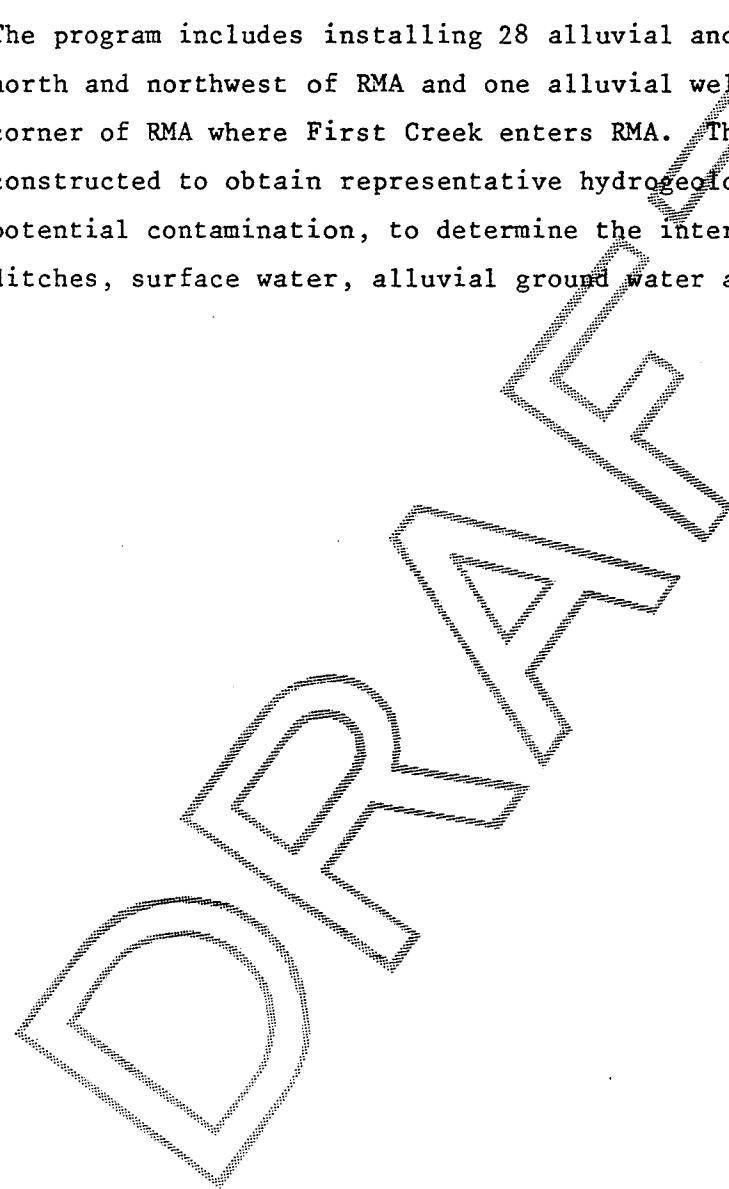
PLATE 1. PROPOSED MONTIOR WELL LOCATIONS



1.0 INTRODUCTION

A portion of the Rocky Mountain Arsenal (RMA) Offpost Contamination Assessment includes the installation of 30 monitor wells in the vicinity of RMA. This report presents the rationale and site conditions representing the placement of the 30 monitor wells.

The program includes installing 28 alluvial and one bedrock well to the north and northwest of RMA and one alluvial well located at the southeast corner of RMA where First Creek enters RMA. The wells will be constructed to obtain representative hydrogeologic data in areas of potential contamination, to determine the interaction of irrigation ditches, surface water, alluvial ground water and bedrock ground water.



2.0 MONITOR WELL NETWORK RATIONALE

Proposed monitor well sites are identified on Plate 1. The specific location of each well is flexible within a radius of 30 meters (100 ft) from the proposed identified site. This flexibility may be needed in obtaining easements, avoiding overhead powerlines, buried gas, water, sewer, and telephone lines.

Well locations were determined using information from the following sources:

1. Consumptive Use Water Quality Data collected in December 1984 and January 1985;
2. Previous 360° data;
3. U.S. Geological Survey Reports; and
4. U.S. Army documents.

Each well was sited to aid in the assessment of one or more of the following categories:

1. Ground water quality beneath populated areas;
2. Contaminant plume delineation;
3. Local hydrogeology;
4. Irrigation ditch and shallow ground water relationships;
5. Surface water and shallow ground water relationships;
6. Shallow ground water and bedrock ground water relationships; and
7. Background ground water quality.

In order to collect the maximum amount of information with the 30 new monitor wells, sites were chosen to provide information related to more than one of the categories listed above. A description of each category is given below.

Ground Water Quality Beneath Populated Areas

Identification of impacts to consumptive use supplies is the primary reason for conducting this offsite contamination assessment. Some well sites will be located in the vicinity of populated areas to provide site specific water quality data for population exposure assessment.

Contaminant Plume Delineation

Previous studies have identified the presence of at least three contaminant plumes. The precise areal extent of the plumes have not been specifically outlined in these studies. Also, concentration gradients of different contaminants in these plumes have not been fully defined. Priority has been given to defining the extent of the plumes and the concentration of contaminants in these plumes. Therefore, a majority of the proposed monitoring wells have been located within or adjacent to known areas of contamination.

Local Hydrogeology

The hydrogeology of the study area needs to be defined over the entire project area so that impacts of offsite water systems can be specifically defined. Minor variations in hydrologic properties, formation composition and the degree of saturation may cause significant variation in contaminant migration. Some sites were located to address quality associated with First and Second Creeks.

Irrigation Ditch and Shallow Ground Water Relationships

Water quality and flow relationships between ground water systems crossing irrigation ditches may relate directly to the potential migration of contaminants to Barr Lake and other locations outside of the study area. Some sites will be used to evaluate the possibility of contaminated ground water entering the irrigation ditch system.

Surface Water and Shallow Ground Water Relationships

The interaction of surface water and shallow ground water defines how contaminants move from either ground water to surface water or surface water to ground water. The rate of flow, dispersion and attenuation of contaminants are governed by the rate and direction of interactions between each component of the hydrologic system.

Shallow Ground Water and Bedrock Ground Water Relationships

The interaction of shallow ground water with bedrock ground water is related to the potential impact of migrating contaminants to the regional bedrock water quality. If hydraulic gradients in the offsite area are

towards the bedrock (downward), degradation of bedrock water may occur. In addition, subsurface conditions might exist such that contaminated water may be entering the alluvium from the bedrock (upward degradation). Paleotopographic lows resulting from erosion prior to deposition of the alluvium and the subsequent infilling of the depressions with alluvium could possibly create a hydrogeologic situation conducive to interformational migration of contaminated ground water from the bedrock to the alluvial aquifer. Such conditions most likely exist in the area north of RMA and south of Boller's well. This is one of the areas where wells in the bedrock will be required to properly define this contaminant migration and geohydrologic conditions. The bedrock is used for consumptive use throughout the Denver Basin.

Background Ground Water Quality

One site will be located near the ~~southeast~~ corner of RMA where First Creek enters RMA. This site will assist in the identification of water quality prior to shallow ground water entering the RMA hydrologic system. Impacts due solely to RMA can only be determined after assessing ground water quality impacts produced by other users upgradient from RMA. Additional wells along the northeastern boundary of the project area may be needed to further define the background ground water quality.

3.0 WELL SITE DESCRIPTION

Proposed Well E-1

Location: 780 meters (m) (2,550 ft) north of the south section line, and 655 m (2,150 ft) west of the east section line of Section 10 (T2S, R67W). The well will be located on the east side of the Union Pacific Railroad access road.

Siting Rationale: 1) Contaminant plume delineation; and 2) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 14 m (45 ft). Depth to the water table has been estimated to be 9 m (28 ft). Lithologic units present include a Holocene-Pleistocene Age eolian sand overlying Pleistocene alluvial deposits. The overlying eolian units are composed of fine to medium grained sand. The alluvium is expected to be composed of silty to clayey sands interlayered with fine to coarse grained gravelly sands. The uppermost bedrock unit in the area is the Arapahoe Formation.

The borehole will be drilled to the alluvial-bedrock contact. The well will be completed in alluvium, with a screened interval extending from within 3 m of the top of the water table to the top of the bedrock.

Proposed Well E-2

Location: 290 m (950 ft) north of the south section line, and 3 m (10 ft) west of the east section line of Section 1 (T2S, R67W). The well will be located on the west side of Potomac Street, south of the Burlington Northern Railroad tracks.

Siting Rationale: 1) Irrigation ditch and shallow ground water relationships; 2) Ground water quality beneath populated areas; and 3) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 14 m (45 ft). Depth to the water table has been estimated to be 10 m (32 ft). Lithologic units present include upper eolian sands of Holocene-Pleistocene Age and a lower alluvial Pleistocene unit. The eolian unit is composed of fine to medium grained wind blown sand. These sands

overlie alluvial sediments composed of fine to coarse grained sands interlayered with silty and clayey sands. The uppermost bedrock unit in this area is the Denver Formation.

The borehole will be drilled to the top of the alluvial-bedrock contact. The well will be completed in alluvium, with a screened interval extending from within 3 m of the top of the water table to the top of the bedrock.

Proposed Well E-3

Location: 358 m (1,175 ft) north of the south section line and 3 m (10 ft) west of the east section line of Section 12 (T2S, R67W). The well will be located on the west side of Potomac Street, north of 104th Avenue.

Siting Rationale: 1) Contaminant plume delineation; and 2) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 11 m (35 ft). Depth to the water table has been estimated to be 7 m (23 ft). Lithologic units present include eolian sands overlying Pleistocene alluvium. Unconsolidated deposits (soils) encountered will be fine to medium grained wind blown sands at the surface. Below these sands, alluvium composed of sands ranging from silty and clayey to coarse grained will be encountered. The uppermost bedrock unit in this area is the Denver Formation.

The borehole will be drilled to the alluvial-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from within 3 m of the top of the water table to the top of the bedrock.

Proposed Well E-4

Location: 3 m (10 ft) north of the south section line, and 884 m (2,900 ft) west of the east section line of Section 2 (T2S, R67W). The well will be located on the north side of 112th Avenue, east of Havana Street.

Siting Rationale: 1) Contaminant plume delineation; and 2) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 18 m (60 ft). Depth to the water table has been estimated to be 8 m (25 ft). Lithologic units present include Holocene-Pleistocene Age eolian sands overlying Pleistocene alluvium. The eolian unit is composed of well sorted, fine to medium sands. The alluvium is expected to be composed of coarse sand intermixed with silty sands. There may be some gravelly sand. The uppermost bedrock unit in this area is the Arapahoe Formation.

The borehole will be drilled to the alluvium-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from within 3 m of the top of the water table to the top of the bedrock.

Proposed Well E-5

Location: At the intersection of the north and east section lines of Section 3 (T2S, R67W). The well will be located on the north side of east 120th Avenue.

Siting Rationale: 1) Ground water quality beneath populated areas; 2) Contaminant plume delineation; 3) Local hydrogeology; and 4) Irrigation ditch and shallow ground water relationships.

Expected Site Conditions: The total depth of the well is anticipated to be 12 m (40 ft). Depth to the water table has been estimated to be 2 m (6 ft). Lithologic units present include the Post-Piney Creek and Piney Creek alluvium, and Pleistocene alluvium. The upper alluvium (Piney Creek) is composed of gravel, sand, silt, and clay. The lower Pleistocene alluvium is composed of similar to slightly coarser material. The uppermost bedrock unit in this area is the Arapahoe Formation.

The borehole will be drilled to the alluvial-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from within 3 m of the top of the water table to the top of the bedrock.

Proposed Well E-6

Location: 1,120 m (3,675 ft) north of the south section line and 3 m (10 ft) west of the east section line of Section 11 (T2S, R67W). The well will be located on the west side of Peoria street, north of the O'Brian Canal.

Site Rationale: 1) Contaminant plume delineation; 2) Irrigation ditch and shallow ground water relationships; and 3) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 14 m (45 ft). Depth to the water table has been estimated to be 6 m (20 ft). Lithologic units present include a Holocene-Pleistocene eolian sand unit overlying Pleistocene alluvium. The eolian sand is a well-sorted, fine to medium-grained, windblown sand. The alluvium is composed of coarse gravelly sands with some silt layers. This site is located along the northern edge of the Denver Formation.

The borehole is anticipated to be completed at the Denver Formation, however, the borehole may be completed at the top of the Arapahoe Formation. The well will be completed in the alluvium, with the screened interval extending from within 3 m of the top of the water table to the top of the bedrock.

Proposed Well E-7

Location: 3 m (10 ft) south of the north section line and 853 m (2,800 ft) east of the west section line of Section 24 (T2S, R67W). The well will be located east 96th Avenue, south of the road, and east of First Creek.

Siting Rationale: 1) Contaminant plume delineation; and 2) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 9 m (30 ft). Depth to the water table has been estimated to be 1 m

(3 ft). Lithologic units present include the Upper Holocene to Post Piney Creek and Piney Creek alluvium and an underlying Pleistocene alluvium. The upper alluvium is composed of gravel, silt and clay of stream flood plains. The lower alluvium is a somewhat coarser gravelly sand with some silty and clayey sands interspersed. The uppermost bedrock unit in this area is the Denver Formation.

The borehole will be drilled to the alluvial-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from 1 m below the land surface to the top of the bedrock.

Proposed Well E-8

Location: 3 m (10 ft) south of the north section line and 1,067 m (3,500 ft) east of the west section line of Section 24 (T2S, R67W). The well will be located along East 96th Avenue, south of the road, and east of First Creek.

Siting Rationale: 1) Contaminated plume delineation; and 2) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 6 m (20 ft). Depth to water table has been estimated to be 3 m (9 ft). Lithologic units present include the Post-Piney Creek and Piney Creek alluvium overlying Pleistocene alluvium. The upper alluvial sediments are composed of coarse sand, sands with silt and clay layers. The lower Pleistocene alluvium is composed of medium to coarse sands, with some gravel interspersed with silty and clayey layers. The uppermost bedrock unit in this area is the Denver Formation.

The borehole will be drilled to the alluvial-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from within 3 m of the top of the water table to the top of the bedrock.

Proposed Well E-9

Location: 15 m (50 ft) south of the north section line and 808 m (2,650 ft) east of the west section line of Section 23 (T2S, R67W).

The well will be located south of East 96th Avenue, and east of Havana Street.

Siting Rationale: 1) Contaminant plume delineation; and 2) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 6 m (20 ft). Depth to the water table has been estimated to be 1 m (3 ft). The lithologic units present is the Slocum alluvium of Pleistocene Age overlying the Denver Formation. The Slocum alluvium is a cobble gravel which may contain boulders. This unit is expected to contain mostly coarse, gravelly sand with some cobbles. There may be finer grained silty sands and clayey sands underlying the gravels.

The borehole will be drilled to the alluvium-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from approximately 1 m below the land surface to the top of the bedrock.

Proposed Well E-10

Location: 358 m (1,175 ft) west of the east section line and 335 m (1,100 ft) south of the north section line of Section 14 (T2S, R67W). The well will be located along Colorado Route 2, east of the road.

Siting Rationale: 1) Contaminant plume delineation; 2) Shallow ground water and bedrock ground water relationships; and 3) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 3 m (10 ft). Depth to the water table has been estimated to be 1.5 m (5 ft). Lithologic units present include the Holocene-Pleistocene eolian sand overlying a Pleistocene alluvium. The windblown sand is fine to medium grained. The alluvium is composed of a gravelly sand with some silt and clay layers. The uppermost bedrock unit in this area is the Denver Formation.

The borehole will be drilled to the alluvium-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from 1 m below the land surface to the top of the bedrock.

Proposed Well E-11

Location: 732 m (2,400 ft) east of the west section line and 625 m (2,050 ft) south of the north section line of Section 14 (T2S, R67W). The well will be located along Colorado Route 2, on the west side of the road, at First Creek.

Siting Rationale: 1) Contaminant plume delineation; 2) Irrigation ditch shallow ground water relationships; 3) Surface water and shallow ground water relationships; and 4) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 11 m (35 ft). The depth to the water table has been estimated to be 0 to 1.5 m (0-5 ft). The lithologic units present are the Post-Piney Creek and Piney Creek alluvium, which cover Pleistocene alluvium. Gravel, sand, silt and clay overlie the alluvial channel deposits which should contain coarser sands and gravels. The uppermost bedrock unit in this area is the Denver Formation.

The borehole will be drilled to the alluvium-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from approximately 1 m below the land surface to the top of the bedrock.

Proposed Well E-12

Location: 389 m (1,275 ft) east of the west section line and 3 m (10 ft) north of the south section line of Section 11 (T2S, R67W). The well will be located along East 104th Avenue, north of the road.

Siting Rationale: 1) Contaminant plume delineation; 2) Irrigation ditch and shallow ground water relationships; and 3) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 14 m (45 ft). The depth to the water table has been estimated to be 10 m (33 ft). The lithologic units present include Holocene-Pleistocene eolian sands overlying Pleistocene alluvium. Surface deposits will be fine to medium grained, well sorted sands of the eolian unit overlying coarser alluvial sediments. The alluvial sediment will be composed of gravelly sands, interbedded with silts and clays. The uppermost bedrock unit in this area is the Denver Formation.

The borehole will be drilled to the alluvium-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from within 3 m of the top of the water table to the top of the bedrock.

Proposed Well E-13

Location: 701 m (2,300 ft) east of the west section line, along the south section line of Section 15 (T2S, R67W). The well will be located north of east 96th Avenue between the Burlington Ditch and the O'Brian Canal.

Siting Rationale: 1) Contaminant plume delineation; 2) Irrigation ditch and shallow ground water relationships; and 3) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 11 m (35 ft). The depth to the water table has been estimated to be 6 m (18 ft). The lithologic units present include the Slocum alluvium of Pleistocene Age which overlies an earlier Pleistocene alluvium. The Slocum alluvium is a very coarse alluvial unit, composed of gravelly sands and cobbles. The uppermost unit in this area is the Denver Formation.

The borehole will be drilled to the alluvium-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from within 3 m of the top of the water table to the top of the bedrock.

Proposed Well E-14

Location: 670 m (2,200 ft) east of the west section line and 610 m (2,000 ft) north of the south section line of Section 14 (T2S, R67W). The well will be located along Colorado Route 2, on the east side of the road.

Siting Rationale: 1) Contaminant plume delineation; 2) Ground water quality beneath populated areas; and 3) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 15 m (50 ft). The depth to the water table has been estimated to be 16 m (18 ft). The lithologic units present include Holocene-Pleistocene eolian sands which cover Pleistocene alluvial deposits. The fine to

medium grained well sorted eolian sands overlie the coarse sands and gravels of alluvial deposits. This borehole will also intersect layers of silts, clays and fine grained sands. The uppermost bedrock unit in this area is the Denver Formation.

The borehole will be drilled to the alluvium-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from within 3 m of the top of the water table to the bedrock.

Proposed Well E-15

Location: 3 m (10 ft) east of the west section line and 960 m (3,150 ft) north of the south section line of Section 14 (T2S, R67W). The well will be located along Havana Street, east of the road, between the Burlington Ditch and the O'Brian Canal.

Siting Rationale: 1) Irrigation ditch and shallow ground water relationships; 2) Contaminant plume delineation; and 3) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 9 m (30 ft). The depth to the water table has been estimated to be 2 m (6 ft) below the surface. The lithologic units present include the Holocene Post-Piney Creek and Piney Creek alluvium which is underlain by Pleistocene alluvium. Gravels, silts, sands and clays of the upper alluvium overlie the medium-to-coarse gravelly sands in the lower alluvial deposits. These sands may be interbedded with layers of silts and clays. The uppermost bedrock unit in this area is the Denver Formation.

The borehole will be drilled to the top of the alluvium-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from 2 m below the land surface to the top of the bedrock.

Proposed Well E-16

Location: 411 m (1,350 ft) west of the east section line and 3 m (10 ft) north of the south section line of Section 3 (T2S, R67W).

The well will be located along east 112th street, south of the road, along an old railroad spur line.

Siting Rationale: 1) Contaminant plume delineation; and 2) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 17 m (55 ft). The depth to the water table has been estimated to be 7 m (23 ft). The lithologic units present include Holocene-Pleistocene eolian sands which overlie Pleistocene alluvium. Fine to medium grained, well-sorted wind blown sands overlie the alluvium which is composed primarily of coarse, gravelly sands interbedded with silty and clayey sands. The uppermost bedrock unit in the area is the Arapahoe Formation.

The borehole will be drilled to the top of the alluvium-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from within 3 m of the top of the water table to the top of the bedrock.

Proposed Well E-17

Location: 625 m (2,050 ft) west of the east section line and 3 m (10 ft) north of the south section line of Section 10 (T2S, R67W). The well will be located along East 104th Avenue, on the north side of the road.

Siting Rationale: 1) Contaminant plume delineation; and 2) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 14 m (45 ft). The depth to the water table has been estimated to be 9 m (30 ft) below the surface. Lithologic units present include Post-Piney Creek or Piney Creek alluvium overlying Pleistocene alluvium. The surface deposits (soils) are composed of sands and gravels with layers of silts and clays. The underlying alluvium is composed of gravelly medium to coarse grained sands. This lower alluvium may also contain some layers of silty and clayey sands. The uppermost bedrock unit in the area is the Arapahoe Formation.

The borehole will be drilled to the top of the alluvium-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from within 3 m of the top of the water table to the top of the bedrock.

Proposed Well E-18

Location: 122 m (400 ft) east of the west section line and 381 m (1,250 ft) north of the south section line of Section 2 (T2S, R67W). The well will be located along the east side of Havana Street, north of east 112th Avenue.

Siting Rationale: 1) Contaminant plume delineation; and 2) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 21 m (70 ft). The depth to the water table has been estimated to be 4 m (14 ft). Lithologic units present include Post-Piney Creek or Piney Creek alluvium overlying Pleistocene alluvium. The gravels, sands, silts, and clays of the Piney Creek layer overlie somewhat coarser sediments in the Pleistocene alluvium. The basal layers will probably be medium to coarse gravelly sands with some cobbles. The uppermost bedrock unit in this area is the Arapahoe Formation.

The borehole will be drilled to the top of the alluvium-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from within 3 m of the top of the water table to the top of the bedrock.

Proposed Well E-19

Location: 6 m (20 ft) east of the west section line and 808 m (2,650 ft) north of the south section line of Section 11 (T2S, R67W). The well will be located along Havana street, east of the road.

Siting Rationale: 1) Contaminant plume delineation; and 2) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 20 m (65 ft). The depth to the water table has been estimated to be

05/14/85

9 m (30 ft). Lithologic units present include Holocene-Pleistocene eolian sands which overlie Pleistocene alluvium. The upper strata are composed of fine to medium grained, well sorted, windblown sands. The underlying alluvium is composed of medium to coarse grained sands and gravelly sand with silty and clayey sand layers interspersed. The uppermost bedrock formation in the area is the Arapahoe Formation.

The borehole will be drilled to the top of the alluvium-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from within 3 m of the top of the water table to the top of the bedrock.

Proposed Well E-20

Location: 518 m (1,700 ft) west of the east section line and 610 m (2,000 ft) north of the south section line of Section 34 (T2S, R67W). The well will be located west of the South Platte River, south of East 124th Avenue, and west of the ~~levy~~ road. A USGS stream gaging station is located across the stream from this location.

Siting Rationale: 1) Contaminant plume delineation; 2) Local hydrogeology; and 3) Surface water and shallow ground water relationships.

Expected Site Conditions: The total depth of the well is anticipated to be 15 m (50 ft). The depth to the water table has been estimated to be 0 to 2 m (0-6 ft). Lithologic units present include Post-Piney Creek or Piney Creek alluvium which overlies Pleistocene alluvium. The sands, gravels, silts and clays overlie alluvial sediments composed of coarse gravelly sands. The uppermost bedrock formation in the area is the Arapahoe Formation.

The borehole will be drilled to the top of the alluvium-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from within 1 m of the top of the water table to the bedrock.

Proposed Well E-21

Location: 137 m (450 ft) west of the east section line and 15 m (50 ft) north of the south section line of Section 9 (T2S, R67W). The well will be located on east 104th Avenue, north of the road, east of Brighton Road and west of U.S. Highway 85.

Siting Rationale: 1) Ground water quality beneath populated areas; 2) Contaminant plume delineation; and 3) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 12 m (40 ft). The depth to water table has been estimated to be 6 m (21 ft). Lithologic units present include the Post-Piney Creek or Piney Creek alluvium which overlies Pleistocene alluvium. The gravels, sands, silts and clays of the alluvium overlie alluvial deposits composed of silty and clayey sands underlain by coarser sands and gravels. The uppermost bedrock formation in the area is the Arapahoe Formation.

The borehole will be drilled to the top of the alluvium-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from within 3 m of the top of the water table to the top of the bedrock.

Proposed Well E-22

Location: 709 m (2,325 ft) east of the west section line and 793 m (2,600 ft) south of the north section line of Section 3 (T2S, R67W). The well will be located along Brighton Road, on the west side of the road.

Siting Rationale: 1) Contaminant plume delineation; and 2) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 12 m (40 ft). The depth to the water table has been estimated to be 2 m (5 ft). Lithologic units present include the Piney Creek alluvium which overlie Pleistocene alluvium near the surface of the drill location. The overlying alluvium consists of sands, gravels, silts, and clays. The underlying alluvial sediments are composed of coarse gravelly sands and silty and clayey sands. The uppermost bedrock formation in the area is the Arapahoe Formation.

The borehole will be drilled to the top of the alluvium-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from within 2 m of the top of the water table to the top of the bedrock.

Proposed Well E-23

Location: 259 m (850 ft) west of the east section line and 427 m (1,400 ft) north of the south section line of Section 9 (T2S, R67W). The well will be located along the east side of Brighton Road.

Siting Rationale: 1) Ground water quality beneath populated areas; 2) Contaminant plume delineation; and 3) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 11 m (35 ft). The depth to the water surface has been estimated to be 6 m (21 ft). Lithologic units present include the Upper Pleistocene Louvier's alluvium which is underlain by early Pleistocene alluvium deposits. The upper alluvium is composed of sand, gravel and clay and may contain some calcium carbonate (CaCO_3). The lower alluvium will consist of gravelly sands with some cobbles overlain by siltier sands and clayey sands. The uppermost bedrock formation in the area is the Arapahoe Formation.

The borehole will be drilled to the top of the alluvium-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from within 3 m of the top of the water table to the top of the bedrock.

Proposed Well E-24

Location: 358 m (1,175 ft) west of the east section line and 335 m (1,100 ft) south of the north section line of Section 14 (T2S, R67W). The well will be located along Colorado Route 1, east of the road. This well is located at the same site as well E-10, however, it will be completed into the Denver Formation.

Siting Rationale: 1) Ground water quality beneath populated areas; 2) Shallow ground water and bedrock ground water quality relationships; 3) Local hydrogeology; and 4) Contaminant plume delineation.

Expected Site Conditions: The total depth of the well is anticipated to be 31 m (100 ft.). The depth to the water table has been estimated to be 7 m (22 ft). Lithologic units present include Halocene-Pleistocene eolian sand which overlies Pleistocene alluvium. Depth to bedrock is approximately 4 m (12 ft). Fine to medium grained windblown sand overlies coarse grained alluvium composed of gravelly sands with some silt and clay. During core drilling of the Denver Formation, interbedded soft shales and harder sandstone units will be encountered. Coring may require the use of a Picture Sampler.

This borehole will be drilled down through the alluvium-bedrock contact and will extend approximately 24 m (78 ft) into the lower Denver Formation. The well will be completed in the first water bearing sandstone (aquifer) encountered in the Denver Formation with the screened interval within the sandstone interval.

Proposed Well E-25

Location: 594 m (1,950 ft) east of the west section line and 3 m (10 ft) south of the north section line of Section 16 (T2S, R67W). The well will be located along East 104th Avenue, on the south side of the road between Bullseye Ditch and Fulton Ditch.

Siting Rationale: 1) Contaminant plume delineation; 2) Ground water quality beneath populated areas; 3) Irrigation ditch and shallow ground water relationships; and 4) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 12 m (40 ft). The depth to the water surface has been estimated to be 2 m (5 ft). Lithologic units present include the Piney Creek alluvium which overlies Pleistocene alluvium at the drill site. The Piney Creek alluvium consists of sands, gravels, silts and clays. The Pleistocene alluvium at this location is expected to contain some cobbles in a matrix of coarse gravelly sands overlain by silty and clayey sands. The uppermost bedrock formation in the area is the Arapahoe Formation.

05/14/85

The borehole will be drilled to the top of the alluvium-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from within 2 m of the top of the water table to the top of the bedrock.

Proposed Well E-26

Location: 3 m (10 ft) east of the west section line and 30 m (100 ft) south of the north section line of Section 21 (T2S, R67W). The well will be located along East 96th Avenue, on the south side of the road between the I-76 Frontage Road (Old Brighton Road) and the south bound interchange for I-76.

Siting Rationale: 1) Contaminant plume delineation; and 2) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 30 m (100 ft). The depth to water surface has been estimated to be 12 m (40 ft). Lithologic units present include the Broadway alluvium of upper Pleistocene Age, underlain by Lower Pleistocene alluvium. The Broadway alluvium is composed of gravel, sand, silt and clay which overlies earlier much thicker alluvial sequence consisting of about 25 m of sandy clays and clayey sands, grading to gravelly sands and gravels with cobbles with depth. Sediments are expected to be much coarser relative to the other wells. The uppermost bedrock formation in the area is the Arapahoe Formation.

The borehole will be drilled to the top of the alluvium-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from within 3 m of the top of the water table to the top of the bedrock.

Proposed Well E-27

Location: 183 m (600 ft) west of the east section line and 30 m (100 ft) north of the south section line of Section 20 (T2S, R67W). The well will be located along East 88th Avenue on the north side of the road, west of the Burlington Ditch.

Siting Rationale: 1) Ground water quality beneath populated areas; 2) Contaminant plume delineation; and 3) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 30.5 m (100 ft). The depth to the water surface has been estimated to be 8 m (26 ft). Lithologic units present include the Post-Piney Creek or Piney Creek alluvium overlying early Pleistocene alluvium. The sands, gravels, silts, and clays of the Piney Creek alluvium overlie a very thick (23 m) alluvial sequence of coarse channel sediments. These consist of finer grained sands and silty, clayey sands grading into coarse gravelly sands, and gravels containing cobbles with depth. The uppermost bedrock in the area is the Denver Formation.

The borehole will be drilled to the top of the alluvium-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from 2 m below the land surface to the top of the bedrock.

Proposed Well E-28

Location: 335 m (1,100 ft) east of the west section line and 762 m (2,500 ft) north of the south section line of Section 29 (T2S, R67W). The well will be located along Brighton Road, on the east side of the road, just south of East 84th Avenue.

Siting Rationale: 1) Ground water quality beneath populated areas; 2) Irrigation ditch and shallow ground water relationships; 3) Contaminant plume delineation; and 4) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 12 m (40 ft). The depth to the water surface has been estimated to be 12 m (40 ft). Lithologic units present include the Post Piney Creek alluvium overlying Piney Creek alluvium. The overlying alluvium contains gravelly sands, silts and clay deposits which overlie channel deposits of gravels and coarse sands and silts. The uppermost bedrock formation in the area is the Denver Formation.

The borehole will be drilled to the top of the alluvium-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from 3 m below the land surface to the top of the bedrock.

Proposed Well E-29

Location: 183 m (600 ft) west of the east section line and 274 m (900 ft) north of the south section line of Section 29 (T2S, R67W). The well will be located along Potomac Street, on the west side of the road.

Siting Rationale: 1) Ground water quality beneath populated areas; 2) Contaminant plume delineation; and 3) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 30 m (100 ft). The depth to the water surface has been estimated to be 14 m (47 ft). Lithologic units present include Halocene-Pleistocene eolian sands which overlie early Pleistocene alluvium. The fine to medium grained eolian deposits overlie a thick sequence of alluvial sediments (25+ m) (82+ ft) consisting of fine grained sands interbedded with clayey sands and silty sands. These grade into coarse, gravelly sands, and gravels with cobbles at depth. There is a good possibility of cobbles being present near the base of the drill hole which may pose a problem in drilling. The uppermost bedrock formation in the area is the Denver Formation.

The borehole will be drilled to the top of the alluvium-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from 3 m below the land surface to the top of the bedrock.

Proposed Well E-30

Location: On the east section line, 823 m (2,700 ft) north of the south section line of Section 8 (T2S, R67W). The well will be located along Buckley Road, across from the trailer park, and south of First Creek where First Creek crosses the eastern boundary of RMA.

Siting Rationale: 1) Background ground water quality; and 2) Local hydrogeology.

Expected Site Conditions: The total depth of the well is anticipated to be 6 m (20 ft). The water surface is very shallow at this location, being near the ground surface. Lithologic units present include eolian sand derived from the alluvium of major streams which is underlain by alluvium. Alluvium between bedrock and the surface sand deposits is

gravely coarse grained sands containing silt and clay layers. The uppermost bedrock formation is the area is the Denver Formation.

The borehole will be drilled to the top of the alluvium-bedrock contact. The well will be completed in the alluvium, with the screened interval extending from 1 m below the land surface to the top of the bedrock.

